Health Hazard Assessment Program Surfaces As Important Player in Army's Acquisition Process

Sound Systems Engineering From a Health or Medical Perspective

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The U.S. Army Medical Department (AMEDD) has provided commanders with informal health hazard information since the first Surgeon General advised General George Washington on diseases in military camps and hospitals, and on hearing loss among his cannoneers.

This informal program continued during the Civil War, World War I, and World War II until the late 1970's. In 1976, during the development of the M198, 155mm Towed Howitzer, the Army identified blast overpressure hazards. As a result, the Army Surgeon General was asked to address this hazard.

Through a combined effort, AMEDD and the [then] U.S. Army Human Engineering Laboratory overcame this blast overpressure hazard, and the weapon was successfully fielded.

As a result of the M198 success, Army leadership, AMEDD, and the materiel acquisition community recognized the need for a formal AMEDD review of new or improved equipment. Acting on that recognition, the Army Surgeon General formally established the Health Hazard Assessment (HHA) Program in 1981.

By 1983, Army Regulation (AR) 40-10, *Health Hazard Assessment Program in Support of the Army Materiel Acquisition Decision Process,* was in circulation.[1] In 1995, the Army Surgeon General designated the U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM), Aberdeen Proving Ground, Md., as the Executive Agent for the HHA program. This article is an overview and starting point for program managers who may wish to know more about recognizing, assessing, eliminating, and controlling any health hazards that may surface in their own acquisition programs.

THE AVENGER, AN AIR DEFENSE SYSTEM MOUNTED ON AN M-998 HIGH MOBILITY MULTIPURPOSE WHEELED VEHICLE (HMMWV) DURING A LIVE-FIRE EXERCISE.

What is Health Hazard Assessment?

Any answer to that question must first begin with a definition of what constitutes a health hazard from the Army's perspective. A health hazard is an existing or potential condition that can result

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JAVELIN ANTI-TANK WEAPONS SYSTEM DURING AN ADVANCED WARFIGHTING EXPERIMENT (AWE) AT THE NATIONAL TRAINING CENTER, FORT IRWIN, CALIF.

M-109A6 PALADIN SELF-PROPELLED HOWITZER DURING AN ADVANCED WARFIGHTING EXPERIMENT (AWE) AT THE NATIONAL TRAINING CENTER, FORT IRWIN, CALIF.

from system design, the environment, doctrine, operations or use and results in health effects ranging from temporarily reduced job performance to death. The Health Hazard Assessment Program or HHA is the Army's response to that threat.

HHA is one of the Manpower and Personnel Integration (MANPRINT) domains that integrate seven areas of expertise into the Materiel Acquisition Decision Process (MADP).[2] Required for all types of acquisition including new developments, materiel changes, and nondevelopmental items, HHA is the process used within the Army to identify, assess, and eliminate or control health hazards associated with the lifecycle management of materiel items such as weapon systems, munitions, equipment, clothing, training devices, and information systems.

The HHA program addresses the potential effects of materiel systems health hazards on the personnel who test, produce, use, maintain, repair, or support the systems. Through application of biomedical knowledge and principles, HHA directly supports Army officials engaged in developing, manufacturing, operating, maintaining, demilitarizing, and disposing of materiel systems. In other words, HHA is systems engineering from a health or medical perspective.

In civilian circles, the HHA program is closely related to aspects of occupational health, preventive medicine, environmental medicine, industrial hygiene/safety, and pollution prevention. The distinction, however, between the HHA program and its civilian counterparts obviously is the program's emphasis on the soldier-system interactions with military-unique operations and equipment.

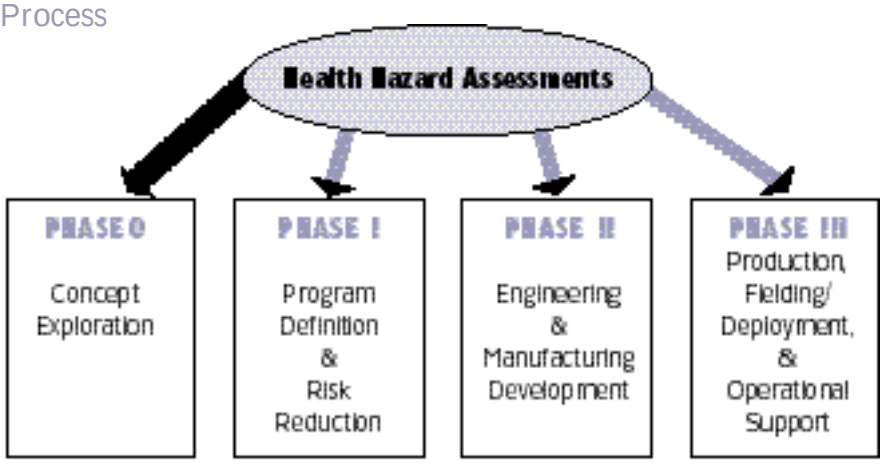
The HHA process considers mission needs, concept analysis, research, development, testing, evaluation, production, procurement, training, use, storage, system maintenance, transportation, demilitarization and disposal throughout the entire life cycle.

health hazards that are not considered, eliminated, or controlled will impact on the one resource the nation cannot afford to sacrifice: the soldier, sailor, airman, and Marine.

How the HHA Program Works

The Army's HHA activities are inextricably linked with its military warfighting doctrine. The individual soldier is the most important element in the performance of Army operations. Since training with future weapons and equipment will create the potential for an increase in adverse health hazard exposures, a decrease in soldier survivability,

FIGURE 1. Addressing Health Hazards During the Acquisition Process



and an increase in environmental contamination, proper management of these hazards is critical to protect Army resources, ensure high quality and realistic training, and improve and maintain readiness. Commensurate with its mission, the goals of the HHA Program are to: eliminate health hazards, reduce injury and illness, enhance soldier performance and system effectiveness, and conserve soldiers' fighting strength.

The Assessment Program

The Army performs HHAs in all phases of the acquisition process (Figure 1) because hazards eliminated or controlled early in the process will inevitably require less attention later in the life cycle.[3] The thicker arrow in Figure 1 shows the critical phase for HHAs within the acquisition process.

Addressing HHA early in the MADP and placing issues into program documents to support the initial milestone decision review, requests for proposal, statements of work, and other program documents are critical. Optimally, identification of health hazards occurs in Phase 0, Concept Exploration, by the formation of a MANPRINT Joint Working Group (MJWG) according to AR 602-2, *Manpower and Personnel Integration (MANPRINT) in the Materiel Acquisition Process.*[4]

The integrated concept team (ICT) and the integrated product team (IPT) are rapidly replacing the MJWG. Institutionalized across all the Services as part of DoD's Acquisition Reform strategy, the goal of the ICT and the IPT is to resolve all health hazard issues during Phase I, Program Definition and Risk Reduction. Ultimately, program managers will find that early consideration of health hazard issues allows for a greater potential to influence design and process changes to prevent health hazards. This approach avoids program delays and costly modifications to the materiel or equipment already produced or fielded.

In addition to supporting decisions on eliminating or reducing system hazards, Army HHA reports support preparation of the following documents:

- MANPRINT Assessments
- System MANPRINT Management Plans
- Test and Evaluation Master Plans
- Detailed Test Plan
- Market Investigations
- Safety Releases
- System Technical and Training Publications
- Milestone Decision Packages
- Statements of Work
- Requests for Proposals

Also, Army HHA reports provide valuable information for source selection evaluation boards, ICTs, and IPTs.

The Assessment Process

The combat or materiel developer initiates the HHA process by sending an HHA request to the U.S. Army Materiel Command (AMC) Surgeon, who provides an important medical interface between the AMEDD and the Army acquisition community. Upon receipt, the AMC Surgeon screens the request package for completeness and identifies potential health hazards. (The request process is detailed later in this article.) If the materiel is free from potential hazards or all hazards are adequately controlled, the AMC Surgeon provides a statement to that effect in an endorsement to the developer. Called a "turnaround," the AMC Surgeon's endorsement serves as the required HHA report documentation.

Systems with uncontrolled hazards are endorsed to USACHPPM by the AMC Surgeon for completion of the HHA report. Upon receipt, USACHPPM assembles a team of subject matter experts

FIGURE 2. Common Health Hazards Encountered with Army Materiel

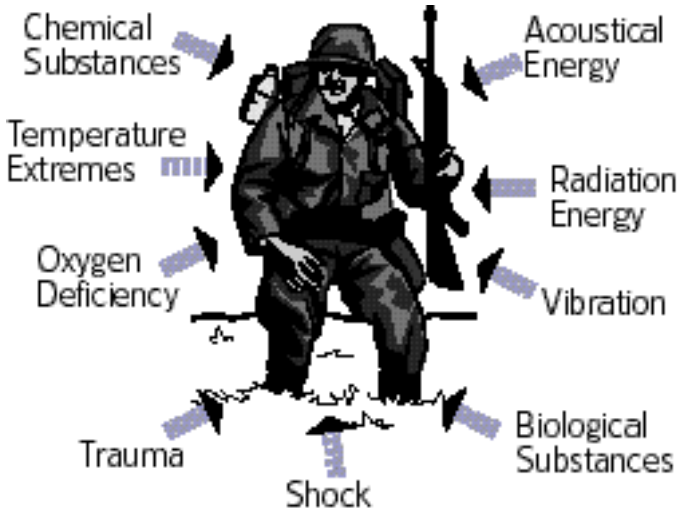
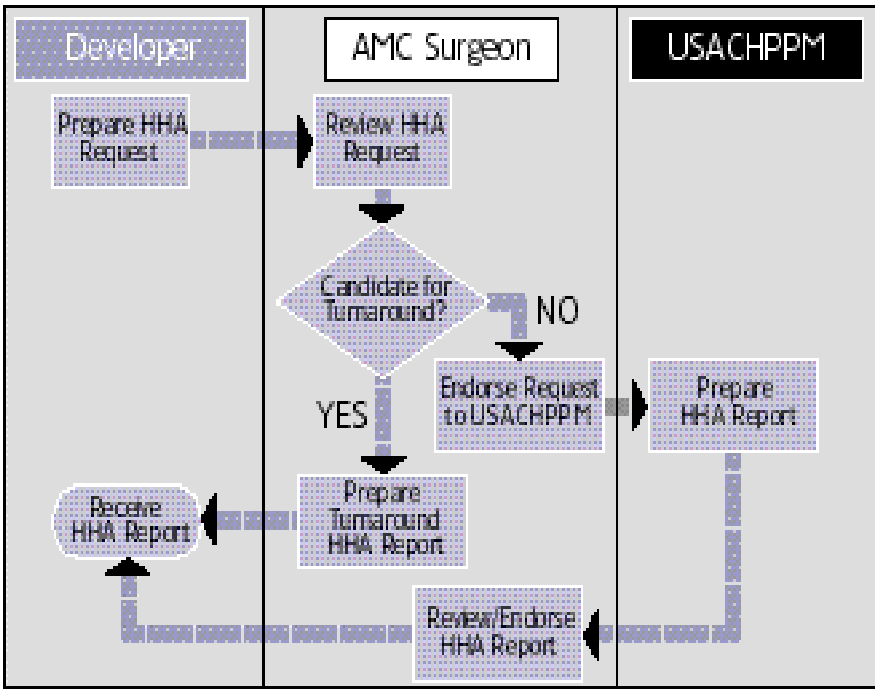


FIGURE 3. The HHA Process



to assess the hazards inherent in the system. Figure 2 depicts the nine most common health hazard categories described in AR 40-10.

Once the subject matter experts complete their assessments, the lead project officer integrates their assessments into an HHA report. The HHA program manager then forwards the completed report through the AMC Surgeon to the developer. A thorough and definitive document, the report also contains recommendations to eliminate or control health hazards. To assist materiel risk managers, the report also provides risk assessments, as well as potential medical costs avoided if the recommendations are adopted. Figure 3 illustrates the complete process.

In addition to the definitive HHA report, several other types of HHA reports exist;

How to Request a Health Hazard Assessment

When a unit, organization, or agency requests an HHA, the assessment is performed by a matrixed team of USACHPPM and other AMEDD scientists and engineers who address the potential health hazard issues and assign RACs to potential hazards. As discussed earlier in this article, requesting an HHA for all types of acquisitions and early in the acquisition process is an important aspect of program safety and ultimate success. Army Lt. Col. Michael J. Leggieri, formerly of the AMC Surgeon's Office, outlines the request process for materiel developers in three easy steps:

3-STEP PROCESS FOR PREPARING HHA REQUEST MEMORANDUM

Step 1. Prepare an HHA request memorandum with the following information:

- Materiel developer's name, address, major command, and phone/facsimile numbers.
- System nomenclature.
- Program category (acquisition category).
- Purpose of the system.
- System components.
- Life-cycle system phase.
- Funds availability to support HHA work (if necessary).
- System prototype availability (where/when).
- Purpose of the HHA (e.g., support milestone decision review).
- Date the HHA report is required.
- Number of systems to be fielded.
- Number and type/military occupational specialty (MOS) of personnel who will work with the system.
- For nondevelopmental items, a description of the health standards applied in the product design and health problems that surfaced during testing or market investigation.

Step 2. Enclose the following information (if available), with your request memorandum:

- Safety assessment report.
- Operational requirements document.
- Mission needs statement.
- System MANPRINT management plan.
- Test and evaluation master plan.
- Detailed test plan.
- Acquisition strategy.
- Independent evaluation plans.
- Integrated logistics support plan.
- Technical test/user test reports.
- Program review documentation.
- Operational summary mode/mission profile.
- Previous HHA reports.
- Record of environmental consideration.
- Life-cycle environmental document.
- Waste stream analysis.
- Other health hazard reports (i.e., reports from commercial vendors, other military services, etc.).
- Sampling data and test results.

Step 3. Send the request to the AMC Surgeon at the following address:
Commander
U.S. Army Materiel Command
ATTN: AMCSG-H
5001 Eisenhower Avenue
Alexandria, Va. 22333-0001

Normally, it takes 90 days from the date of receipt of a complete request package to prepare an HHA report.

FIGURE 4. RAC Matrix

High ← → Low

Severity	Hazard Probability				
	A Frequent	B Probable	C Occasional	D Remote	E Improbable
I Catastrophic	1	1	1	2	3
II Critical	1	1	2	3	4
III Marginal	2	3	3	4	5
IV Negligible	3	5	5	5	5

High ↕ Low

generally, they fall into one of the following categories:

Initial HHA. An initial HHA is performed when adequate information or supporting data is not available. In this case, the HHA program staff request additional information to assess hazards.

Updated HHA Report. An updated HHA report is an assessment of a materiel system that has undergone a modification or upgrade. In this case, only the modification or upgrade and any other portion of the system it affects are assessed.

Quantifying Health Risk

Basically, risk is a probability statement. In the HHA process, however, the term "health risk" combines the probability of exposure to a hazard and the severity of the potential consequences, based on the mission profile or intended use.

The Army assesses health risk with a risk assessment code (RAC) (Figure 4). Estimating the hazard severity (HS) – the severity of the medical effects caused by exposure to a hazard – is the first step. The next step is to estimate the hazard probability (HP) – the probability of exposure to the hazard. The matrix cell where the values for HS and HP intersect shows the appropriate RAC.

The resulting RAC may range from 1 (very high health risk) to 5 (very low health risk). For example, a hazard of marginal severity (HS = III) with an exposure assessed as probable (HP = B) has a moderate overall risk (RAC = 3). The risk assessment matrix is similar to the one described in AR 385-16, *System Safety Engineering and Management*;[5] Field Manual (FM) 101-5, *Staff Organization and Operations*,[6] and AR 70-1, *Army Acquisition Policy*.[7]

The RAC, along with its HS and HP, provides the developer the degree of health risk from unabated hazards. Thus, determining RACs allows the materiel developer to compare and prioritize hazards for elimination.

Quantifying Costs and Lost Time Avoided

Fortunately, a model is available that calculates potential medical costs and lost time avoided when materiel developers implement HHA recommendations (Figure 5). Developed by USACHPPM, the model framework considers the hazard involved, the HS, the HP, and the potential medical outcomes for system operators as a result of an injury or illness. The basic model calculates the estimated yearly costs for clinic visits, hospitalization, lost time, disability compensation, rehabilitation, and survivor benefits for each hazard source assessed. The total is then summed as medical costs per year.

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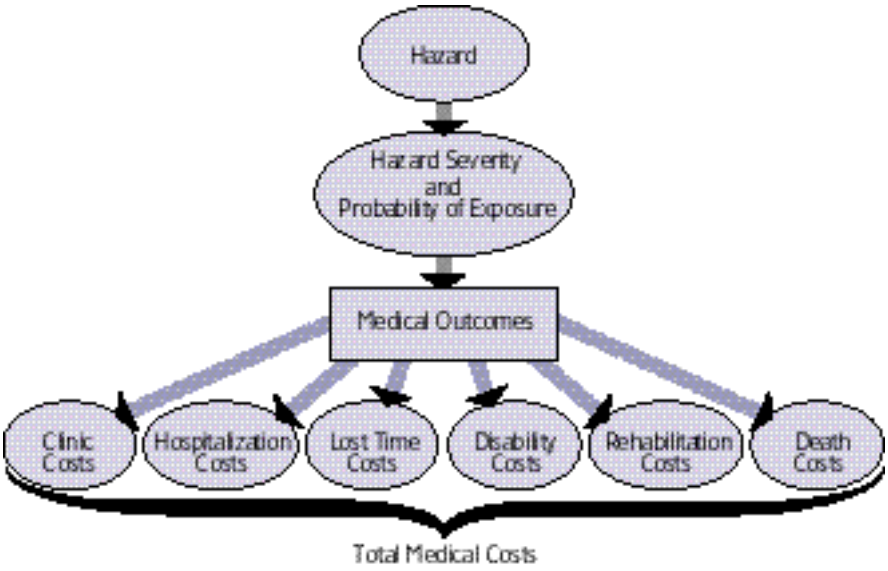
At this point, the HHA report provides a breakdown of the basic cost components to the materiel developer along with estimates of lost time. Once in the hands of developers and acquisition decision makers, this information allows them to see how unabated health hazards might impact readiness and increase a system's total life-cycle cost to the Department of Defense.

Success Stories

Within the HHA program, true success stories abound. Among them are a few highly recognizable, award-winning examples:

The JAVELIN. The JAVELIN is a man-portable, shoulder-fired antitank weapon designed to fire from enclosed positions, foxholes, or in open terrain. Early developmental testing identified the potential for excessive lead exposures associated with the propellant when fired from an enclosure. Additional testing and blood lead analysis determined the extent of the hazard. The AMEDD developed a model to predict the opera-

FIGURE 5. Basic Model for Estimating Medical Costs



tor's lead exposure levels. This resulted in the user's ability to fire up to 12 missiles from an enclosed area, which exceeded the system's combat design criteria.

The PALADIN. The PALADIN is the Army's newest full-tracked, self-propelled howitzer. Early HHA Program involvement with the PALADIN identified lead as a hazard associated with propellant charges used in the weapon. Lead foil in the propellant is used as a decoppering agent for the copper that builds up in the gun tube each time a projectile is fired. The volatilized lead was migrating from the gun tube to the crew compartment. A high-efficiency particulate air filter was added to the ventilation system to eliminate the hazard, and propellant developers are searching for a suitable alternative to lead foil. Lessons learned in the PALADIN were transferred to the CRUSADER Program.

The AVENGER. The AVENGER is an air-defense system using STINGER missiles and a .50-caliber machine-gun turret mounted on the back of a High Mobility Multipurpose Wheeled Vehicle (HMMWV). Weapons are fired remotely or with the gunner in the turret, behind glass. An early shoot-off competition among candidate systems identified gunner heat stress as a significant hazard. The HHA program recommended a cooling system for the crewmembers. USACHPPM's recommendation was originally rejected due to high cost; however, because of experience in Desert Shield and Desert Storm, the AVENGER is being retrofitted with an air-conditioning system.

The AVENGER was also the first system to benefit from a military-unique exposure standard for hydrogen chloride (HCl). The STINGER missile rocket motor generates HCl when fired, and HMMWV cab positions were overexposed during early testing. Engineering controls including rigid door blast deflectors and reinforced body panels were applied. A tri-Service effort with the Committee on Toxicology (National Research Council, National Academy of Sciences) resulted in a realistic military-unique exposure standard for HCl. Application of the engineering controls and military-unique standard facilitated fielding the AVENGER.

Standing By to Help

The Army HHA Program benefits all of the military services since the Army is the lead developer for most land-based warfighting systems. As such, the HHA staff stand ready to provide their expertise in several areas: provide sound technical advice to combat and materiel developers; support acquisition and program meetings as resources allow; prepare HHA reports and other MANPRINT program documents; and annually support about 100 acquisition programs that are in various stages of development.

In summary, health hazards that are not considered, eliminated, or controlled will impact on the one resource the nation cannot afford to sacrifice: the soldier, sailor, airman, and Marine. Ultimately, failure on the part of a program manager to manage health hazards effectively can consume precious procurement dollars and hinder training and readiness.

Editor's Note: For more information, contact the Health Hazard Assessment Program at USACHPPM. Inquiries may be directed as follows:

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Those interested are also invited to visit the USACHPPM Home Page at http://www.131.92.168.27/hha/ on the Internet.

ENDNOTES

1. AR 40-10, *Health Hazard Assessment Program in Support of the Army Materiel Acquisition Decision Process,* Washington, D.C.: Headquarters, Department of the Army, 1991.
2. The other MANPRINT domains are human engineering, system safety, manpower, personnel, training, and soldier survivability.
3. Department of Defense (DOD) Regulation 5000.2-R, Change 1, *Mandatory Procedures for Major Defense Acquisition Programs (MDAPs) and Major Automated Information System (MAIS) Acquisition Programs,* Nov. 4, 1996.
4. AR 602-2, *Manpower and Personnel Integration (MANPRINT) in the Materiel Acquisition Process,* Washington, D.C.: Headquarters, Department of the Army, 1994.
5. AR 385-16, *System Safety Engineering and Management,* Washington, D.C.: Headquarters, Department of the Army, May 3, 1990.
6. FM 101-5, *Staff Organization and Operations,* May 31, 1997.
7. AR 70-1, *Army Acquisition Policy,* Washington, D.C.: Headquarters, Department of the Army, March 31, 1993.